



Fact Sheet

US Army Engineer
Research and Development Center
Waterways Experiment Station

March 2000

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Landslide Mitigation

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Objective: Provide technical assistance in the mitigation of landslides and landslide hazards

Approach: Geologists and engineers of the Geotechnical Laboratory (GL), US Army Engineer Research and Development Center have been involved in applied research and technical assistance in landslide assessment, analysis and remediation, hazard mapping, and monitoring for many years. Landslide investigations have been conducted by GL engineers and scientists in many areas of the U.S. and a number of other countries, including Panama, Korea, the Philippines, Nicaragua, Honduras, Colombia, Venezuela, and Haiti. A brief description of each of these landslide research activities is given below.



Landslide near Pereira, Colombia

Landslide Assessment. The first step in “fixing” existing landslides is the careful and comprehensive assessment of factors that led to the initial and subsequent down-slope movements of the material. Assessments involve detailed field investigations of geologic, soils, hydrologic, topographic, meteorologic, seismic, and human factors which collectively produced the landslide. Assessments may conclude with recommendations for methods and procedures for mitigation of the existing landslide immediate landslide hazards as well as the identification of more detailed geotechnical analysis and monitoring of selected landslides.

Landslide Analysis and Remediation. A comprehensive geotechnical analysis of a landslide is necessary to the development of remedial designs for “fixing” landslides. Unlike assessments, geotechnical analyses include the development of detailed data describing the conditions of the site soils, geology, hydrology, and topography. Stability analyses by numerical (deterministic) evaluation of driving and resisting forces involved in the landslide are conducted. In seismically

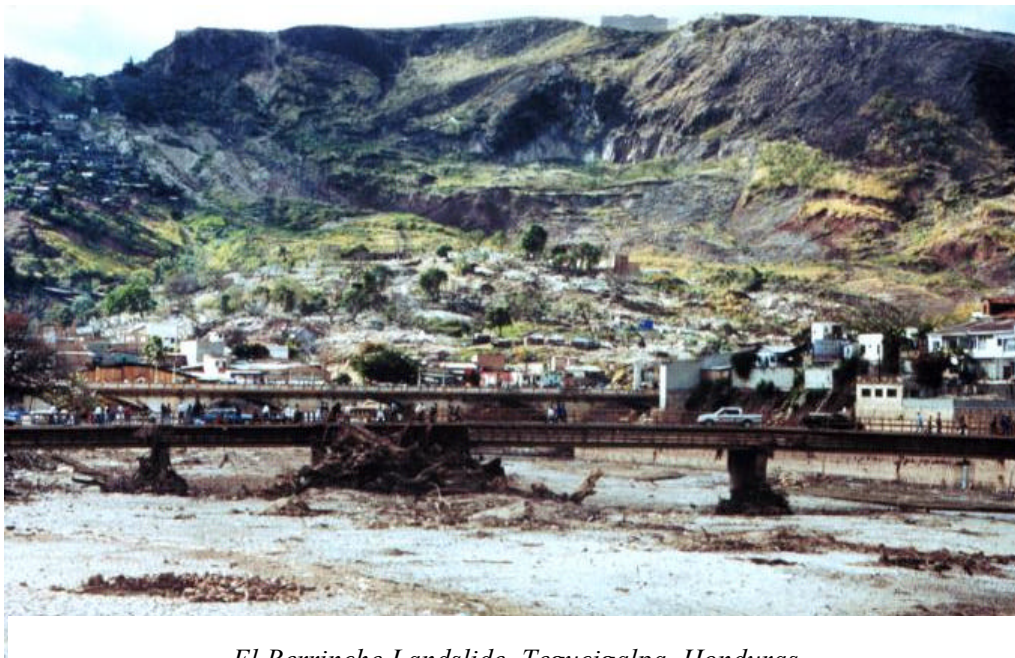
active areas, dynamic analyses of landslides are conducted using ground motions imparted by possible earthquakes. Once the present and potential future stability is determined, various designs for increasing the stability of the landslide can then be evaluated

Landslide Hazard Identification, Mapping, and Analysis. Identification and delineation of areas where existing landslide hazards exist and future landslides may occur are critical to the development of new infrastructure and contingency and emergency plans for landslide-prone areas. This challenge is usually accomplished through at least three steps: (1) mapping existing and previous landslides and the factors that cause landslides; (2) comparing factors collectively (in a Geographic Information System) with the occurrence of natural landslides; and (3) statistical or deterministic analysis of site landslide factors to identify areas of various landslide hazard levels.



Landslide along northern coast of Venezuela

Landslide Monitoring. An important area of landslide research is the measurement and analysis of landslide dynamics as well as changes in the factors that cause landslides. Most landslide monitoring programs include real-time continuous (or relatively high frequency) measurement of the temporal and spatial variability of mass movements at and beneath the surface, micro-topography, soil moisture and ground water levels, and precipitation. Typically, these measurements are collected at a central data recording and transmission point on the site. Often these data are used in a landslide warning system in high-risk areas.



El Berrinche Landslide, Tegucigalpa, Honduras